# The American Biology Teacher

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Figure 1. Brookline High School Biology Laboratory, a workshop for student project activities.

## Biology Nights


IRVING C. KEENE

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How many times have you had students ask you in class whether it will be possible to study and discuss further certain phases of biology in which they are especially interested. Have you not had girls, planning on entering the nursing profession, ask if more time can not be devoted to the unit on human anatomy? What about the boy or girl who has a hobby of a biological nature and would like to explain his or her work before the class?

Figure 2. Visitors inspecting the exhibits.

Our biology courses given in secondary schools are required partly because of college entrance examinations (which only a minority of students actually take) and cover so much subject matter in such a short space of time that it seems impossible to find time to satisfy the individual interests of our students.

Scientists are constantly reminding us that something should be done to search for and encourage future scientists in our secondary schools. One answer seems to be through student project work followed by an exhibit before the public, which we call in Brookline "Biology Nights."

I first started this interesting and worth-while activity ten years ago. After investigating and writing about a project which greatly interested them, the students presented exhibits of their research in the laboratory before their parents. It proved so successful that the following two years they conducted the exhibition in a small auditorium. The past seven years, my students have made and gathered so much exhibit material concerning their projects, and their parents, science educators, and the public in general have become so interested in their work, we found it necessary to move into our gymnasium which is 100 feet long and 60 feet wide. "Biology Nights" on June first and second, 1947, attracted a total of 5,462 people, including many outstanding scientists and educators.

Project work begins the first week in October. A list of approximately 200 projects is placed on the clipping board in the laboratory. I have included in this article a list of some of the most popplar projects my students have selected over a period of years. The boys and girls are given all the freedom possible in selecting their project, either from my list or their own choosing. Students I had in the past have added many new projects to my original list.

I stress three points in advising them on their selection. First: Are you extremely interested in your project? It is my opinion that there is no learning without interest. Second: Can your project start you in a hobby or can it further a hobby already begun? Examples of this type of project would be *Nature Photography*, *New England Butterflies*, *A Study of New England Trees*, *Fish and Fishing*, *New England Song Birds*, and *A Study of Marine Life*. Third: Can your project aid you in your planned life's work? Projects which are popular in this group would be *The History of Nursing*, *Laboratory Technician Work*, *United States Forest Service*, *The Study of Teeth*, *Study of the Human Eye*, and *A Study of Human Skin and Cosmetics*.

Each student is given two weeks to investigate his project. If he decides upon investigation that the project does not interest him as he at first thought it would, he is allowed to select another project. Everything is done to make

him feel free and independent, both in selection of his project and the research which follows. It is my opinion that youth of high school age should be given more opportunity to work out their own problems. After the student is certain he wants to continue with the project selected, he starts his investigation. We make certain that each student understands and follows the scientific method of approach. He has stated his problem and now he starts collecting facts. He does not limit himself to our school and local libraries, but seeks books and other references from the Boston Public Library and from libraries in near-by colleges. He sends out letters to authorities in his field seeking information. He arranges to make interviews with specialists in his field such as professors, doctors, and plant technicians. Most of our students make at least four interviews. Is not this a worth-while experience for our young people?

After gathering all the information they can through reading material, interviews, and personal experiments, students are now ready to write their reports. We stress quality, and not quantity, yet some of the reports contain more than 10,000 words. Some students think so much of their reports that they have them professionally bound.

After completing their reports, the students start gathering material and making exhibits for the "Biology Nights" exhibition. They set their exhibits up on a Sunday in our gymnasium so that the exhibit may be open to the public the following Monday and Tuesday nights. Each student furnishes his own card table and in case the exhibit is a heavy one, he builds it up from the floor. The use of the card tables, all of which measure about the same, simplifies the laying out of the exhibition hall. We allow parents to bring in the exhibits but they are not allowed to help set them up. Should we not do all we can to encourage parents to take an interest in the school activities of their boys and girls?

Our Biology Club sponsors "Biology Nights." Each member acts as a counsellor for about five exhibitors. The counsellor helps them in such regards as the location of their tables during the exhibit, loans of material from our laboratory, transportation of material to the exhibit hall, and in some cases aids them in seeking advice on the proposed exhibit. It is surprising how much work my club members can get the students to do. In some cases the students will do much more for one of their own age than they will for a teacher. The club sends out the invitations to attend "Biology Nights" to schools, colleges and other leaders in our field. They arrange the entire program, which includes speakers and special biological motion pictures. Last year we were privileged to have Dr. Harlow Shapley, of Harvard University and past president of the A.A.A.S., address us and present the awards.

Figure 3. Admiring the Orchid Exhibit.

I would like to stress the importance of having the students at their exhibit tables explain their projects to the visitors. It is my opinion, that this opportunity


Figure 4. A Nature Photography Exhibit.

my students have of talking with many people and explaining their projects instills a confidence in themselves that is most valuable in their training for later life. Many parents have told me how much that experience has done for their sons and daughters to overcome a lack of confidence in themselves. I have served as judge in science fairs where the exhibitors are not required to be present. It seems to me that a most valuable outcome of an exhibit of this nature was missed.

The exhibits are judged by ten biology teachers, five from the college level and five from the high school level. We give prizes to the ten best exhibitors. There are 10 points considered, yet the two most important are "Has the student a good knowledge of the subject," and "Did he originate and construct his own exhibit?" since doing is learning. The awards are made on the second evening of "Biology Nights." One of the greatest thrills I get from this activity is to witness the enthusiasm written all over the faces of these young people as they anxiously await the decision of the judges.

The attendance at "Biology Nights" has been growing each year. Last spring, as stated before, our attendance was 5,462 people during the two evenings. One hundred and ten students set up 330 table spaces of exhibit material which completely filled the gymnasium. We have biology teachers with their students visit us from schools a considerable distance away. I have found that this activity gives the parents and general public a clearer understanding of the broad scope of our field, and a greater desire among our freshmen to take biology in their sophomore year. I have tried to point out a few of the benefits to our students in undertaking a project and exhibiting before the public; the reader will think of many other worthwhile benefits. One of my greatest pleasures comes from working with these young people after the formal class period is over, when I really learn to know them and to understand their many problems.

Many teachers have asked me how much time this activity takes from the regular class work. Each student is, from time to time, provided with mimeographed copies of instructions. Since all individual instruction takes place after school hours, my regular class work is not interfered with. Naturally, about two days before "Biology Nights" there will be a few instructions that will have to be emphasized.

I have included a series of pictures taken at "Biology Nights" which will give a general idea of the exhibit. I feel I am fortunate in teaching in a school where the Superintendent of Schools, Headmaster, and Head of the Science Department fully appreciate the value of this learning activity to our boys and girls and support me to the fullest extent.

Science teachers in this vicinity are pleased that our local Academy of Arts and Sciences, realizing the need of doing all we can to train scientists for the future, is conducting a New England Science Fair for the first time this spring. The prize winners of four regional New England Science Fairs will exhibit at this final exhibition.

Our "Biology Nights" will come this year on May tenth and eleventh in the Brookline Municipal Gymnasium. We invite all to attend for we feel certain you will benefit by attending and will be amazed what these young people can do in our field if interested, encouraged, and properly guided.

Please feel free to write concerning any questions you might have to ask one who has had ten years of fun conducting "Biology Nights."

## LIST OF POPULAR BIOLOGY PROJECTS

### PLANT KINGDOM

1—New England Wild Flowers
2—New England Evergreens
3—Soilless Gardening
4—National Parks
5—Christmas Greens and Decorations
6—Lawns and Their Care
7—Taxonomy of Flowering Plants
8—Study of Orchids
9—Plant Breeding
10—A Model Rock Garden
11—Greenhouses
12—Study of Flowers
13—A Model Vivarium
14—Study of Commonly Used Herbs
15—Study of Pollen Grains
16—Collection of Weeds
17—A Study of Mosses and Ferns
18—Desert Terraria
19—U. S. Forest Service
20—Plants for the Home
21—A Study of Cacti
22—Marine Plants
23—A Study of Rubber
24—A Study of Coffee and Tea
25—The Study of Cotton
26—The Study of Medicinal Herbs
27—The Study of Insect-eating Plants
28—A Study of Mushrooms
29—A Study of Germination
30—Bacteriology

### ANIMAL KINGDOM

1—Fur-bearing Animals
2—Bird Houses and Feeding Devices
3—Edible Molluscs
4—A Collection of Birds Eggs
5—New England Song Birds
6—Tropical Fish
7—Study of Horses
8—Study of Poultry
9—Study of Amphibians
10—New England Snakes
11—A Study of Pond Insects
12—Household Pests
13—The Conservation of Birds
14—New England Butterflies
15—Fish and Fishing
16—Study of Water Birds
17—Fresh Water Biology
18—Insect Collecting at Night
19—Study of Worms
20—Marine Life
21—Wild Life Conservation in New England
22—The Study of Shells

### HUMAN ANATOMY AND DISEASES

1—Effect of Athletic Sports on the Human Body
2—Study of the Nose, Mouth and Throat
3—Tobacco and Its Effects on the Human Body
4—Effects of Alcohol on the Human Body
5—Study of the Human Stomach
6—The Effect of High Altitude Flying on Man
7—The Human Ear
8—The Human Eye
9—The Human Heart
10—Study of the Common Cold
11—Study of Heredity
12—Study of Blood and Circulatory System of Man
13—Dermatology
14—Study of Hair and Nails
15—The Human Skeleton
16—Study of the Brain
17—Study of Malaria
18—Infantile Paralysis
19—Study of Teeth
20—Conquest of Disease
21—The Evolution of Man
22—Study of the Respiratory System

MISCELLANEOUS

1—Study of Foods
2—A Study of Skin and Cosmetics
3—Study of Vitamins
4—Study of the Microscope and Its Work
5—Makers of Biology
6—Our Water Supply
7—History of Surgery
8—The Sulfa Drugs and Penicillin
9—The Story of Milk
10—The Story of Cheese
11—Exploring a Sea Beach at Ebb Tide
12—Boy Scout Merit Badge Work
13—The Study of Bees
14—Art in Relation to Biology
15—Nature Photography
16—Laboratory Techniques

A TEN-YEAR CUMULATIVE INDEX? Thus far only three readers have responded to the request for opinions on this subject. All three were strongly in favor, but three out of almost 2000 members does not constitute a representative group. Unless there is a definite desire for the index, the labor necessary to compile it will not be justified.

If you think the project worth while, be sure to write the editor about it in the near future, because plans for the index if there is to be one, must be laid soon. To be of greatest value the index should appear immediately after the close of the tenth volume, which ends with the *December 1948* issue.

# An Introduction to the Identification of Plants

VERNA M. WEEMAN
Senior High School, Albany, Oregon

*Objectives:*

1. To learn to identify some of the plants in the immediate surroundings.
2. To learn about landscape design by observing the school yard.
3. To learn the uses of certain trees and shrubs.
4. To practice landscape design on a small scale.

*Time:* Approximately one week.

*Concepts:*

1. Everyone needs to learn to identify certain plants and certain animals. Ask the students to try and think of a person who does not need this knowledge. Even the city dweller must be able to recognize dogs, cats, mice, and certain vegetables and fruits with which he comes in contact, just as the other extreme, a savage or hermit who lives closer to nature does.
2. In order for plants and animals to be identified they must be organized into groups with similar characteristics. Ask the students to name some of the animal groups—fish, snakes, protozoa, insects. Ask them to name plant groups—trees, shrubs, vines, bacteria.
3. Each plant and animal has one scientific or Latin name and may have several English or common names.
4. Latin is used for scientific naming because:

   (a) It is a finished language and therefore the words do not change in meaning. Ask the students to think of examples of words whose meanings are changing with use today.

   (b) It is a universal language used for all scientific naming all over the world and therefore scientists need to learn only one other language (Latin) besides their own.

A group of students identifying English Laurel.

*Activities:*

Divide the class into groups of four people (one unit). Each unit should choose a recorder to write down the unit's findings. Allow the units to go outside and find out how well they really know the surrounding plants. Ask them to make a list of the names of all the plants they know growing within the four side walks surrounding the school building. The unit who lists the largest number of correct names (either common or scientific) will be the winner. Give two points instead of one for the scientific names. The units should return to the room shortly before the end of the class time and leave their lists to be checked by the instructor.

After you have announced the winning unit, explain that it is not too surprising that the students did not write down more plants. Most young people aren't as aware of their surroundings as older people. However they will learn more about these plants as they continue their class work. It is not expected that they will become landscape architects but most of them do have yards around their homes and someday may plan a yard of their own. It can be very interesting and also save money if they know how to do it correctly. It takes careful observation to discover the tricks. Discuss with the students places in the community where studies may be made. Plan to study the school landscaping.

With the aid of the students draw a diagram of the school block on the blackboard. Students should make a similar "rough draft" of their own. When it is understood how the building and grounds are arranged the students are ready to learn about the plants. Large classes may have some difficulty but ours (32 members) worked out successfully although it was felt that a little talk at the beginning of the trip was necessary to have everyone get in and work.

Take the class outside again and tell them the names of the plants along with as many associations as you can give for each. Students should write down the names on a list, giving each new name a number and drawing circles on the rough sketch with the number of the plant in the center of the circle. This will avoid repetition of name writing and give the student more time to get acquainted with the plants.

Upper: Boys trying to determine which species of cedar they have.

Lower: Students beginning on their final drawings.

Our school landscaping worked out well because it is symmetrical and many of the plantings are the same. It gave a good opportunity for review as we went along. We had thirty different kinds of plants.

It may take two lessons to get around the school yard. When these trips are completed it is time to make the formal drawing. Write the directions on the blackboard giving measurements, scale, numbers and correct spellings for plant names etc. Students should have their drawings checked before inking them. Use india ink and print the key and labels. Stress neatness. When this is turned in the project is complete.

*Extra Credit Projects:*

1. Plot your own or a neighbor's yard. Devise and describe two landscaping improvements. Make a key for the plants. Label clearly.
2. Plan and plot landscaping for an ideal yard you might like to have. Provide key. Include necessary features such as garbage can and clotheslines.
3. Plan a continuous blooming flower garden. Plot and make a key.
4. Make a chart showing the different trees, shrubs, flowers etc. and their possible uses. Include sketches or pictures of important features such as blooming period, special care, height, etc.

Encourage students to use magazines, seed catalogs, and such local sources as are available, florists, nurserymen, etc.

*Evaluation:*

Final chart

Extra credit projects

Test over the Plants (samples may be brought into the room and numbered for students to identify or colored slides may be shown for identification).

MR. M. C. LICHTENWALTER of Lane Technical High School, Chicago, former president of THE NATIONAL ASSOCIATION OF BIOLOGY TEACHERS and now a member of the advisory staff of *The American Biology Teacher*, has undertaken the task of assembling from time to time brief items dealing with laboratory aids and the like. This column (we hope it may become "page" or "pages") is an extension of the former *By Thy Way*, which will now be broadened in scope. The tentative title for the feature is *Biology Laboratories*. It will be started in the October issue and appear as often and as extensive as the number of available items dictates. Like its predecessor, this column must come from the readers to be successful. Any brief items are welcome. If you have a snapshot or drawing to illustrate the point, so much the better. Send the items to M. C. Lichtenwalter, 5061 N. St. Louis Ave., Chicago 25, Illinois.

# The Use of Physical Concepts in Teaching Biology

AARON J. SHARP
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Much of biology consists of applied chemistry and physics; yet the most of our elementary biology is taught today without making adequate use of these sciences, particularly the latter. There are several reasons for this: (1) the limited basic training of the teachers, (2) the meager background of the students, (3) the inertia of the teachers, (4) the failure of most biological textbooks to use correct chemical or physical explanations. In these modern times with so much emphasis on the physical sciences in our daily lives, we are derelict in our duties if we fail to use these sciences adequately in our biology teaching.

One phase of physics most neglected (and which will serve as an example) in the teaching of biology is that of molecular motion and diffusion. The following statements are frequently heard and accepted in our classes: "Plants take in and give off water"; "The body gives off carbon dioxide through the lungs"; "The capillaries take food from the alimentary tract." Not only are these statements inadequate but they obscure the physical phenomena which are involved, and they perpetuate misconceptions of long standing.

It is not too difficult to get children of average intelligence to visualize that the world and its inhabitants are composed of various minute particles, molecules, *all of which are in motion.* It is a concept which they cannot get too early in life, and it is most fundamental to an understanding of the universe in which they live. Nor is it impossible for the students to visualize living membranes: the tissues of a root, the lining of the lungs, the wall of a blood vessel, etc., serving as screens through which the various molecules move with more or less freedom. For instance, a water molecule generally passes through a living membrane more readily than a sugar molecule. Even though both may pass through, they do so quite independently of each other.

The relative number of molecules of a given substance which are bombarding the two sides of a membrane at any given time determines the direction in which the greater number of molecules of this substance will pass through the membrane. For example, if there are more water molecules hitting the root membranes from the soil solution on the outside than from the sap on the inside of the root, the net result will be an increase in the amount of water in the root system as a result of diffusion. This phenomenon (further exemplified in the following paragraphs) is often referred to as *osmosis.*

Another example is the diffusion of glucose into the blood stream from the intestines. If as a result of ingestion and digestion, the number of glucose molecules which hit the lining of the intestines from the interior is increased over those which are bombarding it from the blood, the net result will be an increase of glucose in the blood.

The movement of soluble foods from the capillaries to the individual cells can be satisfactorily explained on a similar physical basis. It must not be forgotten that the molecules of each substance

move independently of the molecules of every other substance.

The loss of water from plants into the surrounding atmosphere (transpiration) is due to the fact that there are more water molecules from the plant sap bombarding and passing through the membranes separating the interior of the leaf from the atmosphere (intercellular space) than there are water molecules passing into the leaf from that same atmosphere. Should the atmosphere become saturated more water might move into the leaf from the exterior than would be leaving.

Factors which cause the concentration or speed of molecules to change will indirectly affect the rate of diffusion. Thus, the addition of fertilizers (solutes) to soil water (solvent), digestion, a change of temperature, a change in atmospheric humidity will each affect some of the diffusion phenomena described above.

One of the many advantages of the above physical concepts is that they place the action where it belongs: "*the molecule* of water moves into or out of plants" rather than ascribing it to the tissue or organism: "*the plant takes in* and *gives off water.*"

While it is admitted that there are still higher levels of interpretation, the above explanations more nearly approximate the facts than those more frequently used and therefore are more stimulating to further inquiry. They certainly lead the student to a better understanding of his universe.

# Nursery Inspection—A Form of Applied Biology

RALPH W. DEXTER
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Biology teachers are frequently called upon to justify their teaching subject in the school program. They should also be prepared to point out to their students, especially those interested in following up biology as a career, the multitudinous ways in which biology plays an important part in the broad fields of medicine, agriculture, plant and animal industries, and conservation. In recent years more and more emphasis has been given to the economic and cultural aspects of biology. It is realized that for the general student it is much more important to understand the role of biology in his civic life than to know the details of earthworm anatomy or the names of frog musculature. Textbooks often devote a chapter to the importance of biology to the welfare of modern man. The common applications are well known, but little or nothing has been written about the field of nursery inspection which should receive attention by educators.

Nursery inspection is important in the field of biology teaching for three reasons. First, landscaping is no longer confined to wealthy estates but is rapidly becoming a part of the maintenance of the average American home. Nurserymen who formerly propagated ornamentals for large-scale landscaping have found that the best market now is producing smaller plants suitable for the yard and house borders and gardens of the average householder. More and more homes are being planned with attention given to the outside decoration as well as to inside decoration. The

average home owner or tenant is now concerned with matters of disease and pests of ornamental and fruit-bearing plants. Secondly, state laws require nursery stock to be inspected annually before issuing the yearly license to protect the public, and these laws enforce special inspection of plants which require certification for interstate shipments. This service gives employment to those trained in practical biology. And thirdly, nursery inspection, because of its seasonal character, can be carried out by teachers and advanced students of biology employed on a temporary basis during school vacations. This convenient arrangement gives an additional supply of skilled personnel to the inspecting crews when the load is heaviest and gives seasonal employment to trained biologists when they might otherwise be idle.

Nearly all states have commerical nurseries varying from those with hundreds of acres of stock and doing business on a national scale to spare-time nurseries of a single man. The diseases and pests infesting the stock naturally vary with the region, climate, year, and kind of plants propagated. In Ohio, one of the leading producers of commercial plants, over 200 diseases and pests have been reported on nursery stock. Nearly half of these are of considerable importance. The diseases are caused by viruses, bacteria, and fungi. Most of the animal pests are insects, but occasionally they are nematods, sow bugs, red spiders (mites), or millipeds. Not only does the inspector prevent infested plants from being sold and scattered into new areas, but he assists the nurseryman in making plans for combating the diseases and pests to prevent their spread in the nursery. Some of the more common pests and diseases found by the writer on nursery plants while serving as a deputy inspector, selected to give a variety of both host plants and pests, will be mentioned here to serve as teaching material and as a guide to further study on the subject.

Some of the young peach trees were found infested with the peach tree borer and the peach twig borer. The first of these is the larval stage of a clear-winged moth. The eggs are laid on the bark of the trunk and the newly hatched larvae tunnel into the sapwood where they destroy the cambium, often girdling the young saplings, and in any case resulting in loss of sap and leaving the way open for other borers and fungus diseases. A gummy secretion near the ground betrays the presence of this borer. Young trees with this pest must usually be destroyed, especially if the cambium layer is girdled. The peach twig borer is an introduced moth from Europe and belongs to a different family from the preceding species. The larvae burrow into the shoots at springtime causing the buds to unfold and wither. In the summer they tunnel through both the twigs and fruit. Severe pruning is required to remove the pest.

On raspberry plants four common diseases were encountered. Two of them were caused by viruses—mosaic and leaf curl—while the others were crown gall, a bacterial disease, and orange rust, a fungus disease. All of these are of such a serious nature as to require the destruction of the infested plants.

Young elm trees were occasionally found to be attacked by the European elm scale, an insect which may kill the smaller trees and destroy the branches of larger ones. Also, honeydew secretions from the scales attract flies in great swarms. Spraying with full-strength dormant oil in early spring is the only effective control measure known

other than destroying badly injured trees. On lilac bushes the oyster-shell scale, another European introduction, was often abundant. Of all the scale insects found on Ohio nursery stock, this is the most difficult one to control. Destruction of the plants, especially when heavily coated with scales, is the only sure way of stopping the spread of this pest. Spraying with a miscible oil or nicotine sulphate while the young scales are in the "crawler" stage is helpful if attended to before the insect becomes too numerous. Another injurious insect of this shrub is the lilac borer, the larva of a clear-winged moth related to the peach tree borer. A sphecid wasp hunts out these borers for prey, and careful observation of these large wasps often leads to the discovery of borer infestations.

Pines of various species were subject to attack by the pine needle scale and the European pine shoot moth. The first of these forms a white crust of scales over the needles which is very conspicuous, often giving the foliage the appearance of being white-washed. Such large numbers may kill the trees. Spraying with dormant-strength lime-sulphur or oil is recommended. The larvae of the European pine shoot moth tunnel into the ends of the twigs causing resin to flow and destroying the buds. Thorough pruning of the infested twigs and spraying with lead arsenate and fish oil are necessary to prevent further spread. On spruce trees the eastern spruce gall aphid was the most frequently encountered pest. It was easily discovered by the presence of large thorny galls which it produces on the twigs. Pruning and spraying nicotine sulphate are the methods of treatment. On junipers, juniper webworm and juniper scale were the most important pests. The scales were often abundant, forming a grayish crust over the leaves from which they suck the juices of the plant. Dormant-strength lime-sulphur, the best spray, must be used before new plant growth begins in the spring. The webworm is found mostly in the Irish and Swedish types of junipers. Here the caterpillar binds the needles together with webbing in the thick foliage to form a tube in which it lives. Forceful spraying with lead arsenate to penetrate the silken nest with this stomach poison is necessary. Junipers with very heavy infestations of either scale or webworm should be destroyed. Varieties of yew, which have recently become some of the most popular ornamental evergreens, are attacked by the Taxus mealy bug. This insect forms puffy, silky masses in which they live among the inner layers of needles. Forceful spraying of a contact insecticide such as *Loro* is needed to break open the silky fibers and destroy the mealy bugs.

Gladioli are subject to a disease known as root rot caused by a soil fungus. It may also produce wilting of the plants without showing signs of rot. Such plants must be destroyed. Chrysanthemum plants were occasionally found serving as hosts to the Chrysanthemum midge or gall fly which forms galls in the flowers and leaves, and the European corn borer which bores into the stems. Contact sprays for the midge and pruning out stems containing the borer, which is the larval stage of a moth, are the control methods. When infestation is very severe, the plants should be destroyed.

While examining nurseries for diseases and pests, the inspectors are always on the alert to discover and report those enemies of plant life, such as the Japanese beetle, which are being investigated by the Federal Bureau of Entomology and Plant Quarantine.

This is another agency which is engaged in the application of biological knowledge to the control of pests which are detrimental to human welfare and offers another avenue for the employment of professional biologists.

# The Morphological Mystagogue

ARTHUR J. BAKER
Crystal Lake Community High School, Crystal Lake, Illinois

Fellow pedagogue, if you are one who may be of the opinion that there is no room in teaching for a bit of the thespian, then this is not for you. As good food is improved by spices, as a flower is made more desirable by its scent—so, too, is good teaching able to better impress and instill scientific fact by an occasional use of the dramatic.

The differences between Monocotyledoneae and Dicotyledoneae, subdivisions of the class Angiospermae, had been presented to my biology classes by the usual methods of text and reference readings, lecture and explanatory charts. A brief outline of the next day's class follows. In your writer's opinion, it transformed a bit of dry (to the average high school student) material into something vital, meaningful and most worthwhile.

"Come up here, Jerry. Thank you. Jerry, this is the magician's throne; and you are now KING OF THE MYSTICS. Take your throne, and if you promise to hold in your right hand this baton, the symbol of magic power, you shall be gifted immediately with a profound knowledge. In short, Jerry, yours is so great a gift that you can answer questions correctly, even though you think you do not know the answers."

"Jerry, how many petals are there on the flower of the Iris? Do you know the answer to that?"

"Well," said Jerry, "A neighbor of ours had some in her flower garden that were in bloom last, let's see now, June, I think it was. But, Gosh, I couldn't remember how many petals they had."

"You see, class, Jerry, the biology student, cannot answer the question put to him. But wait— I'll wager Jerry the Mystic can do it."

At this point the instructor takes from his desk a bottle containing a preserved Iris leaf and hands this to the student.

"Now, Oh mystic, examine this leaf of the Iris closely. While you do this, please be waving the magic baton over the bottle. Fine. Now the number of petals on the Iris can be found somewhere between one and one thousand. I shall give you but three chances, my mystic. Can you come through for us?"

Jerry mumbles something about paralleled veins, then says, "I have it now! It *must* be three, six or nine. No wonder you gave me three chances. From what I remember from the size of the flower, it is most likely nine."

"Nine is right, Jerry. One chance in a thousand and he bats a perfect score. Shall we try him again, class?"

A chorus of "Yes, yes" comes from the class.

"Make ready, mystic. On yonder North window is an African Violet in bloom. Can you tell us the number of petals on its flower?"

"I guess I'm stumped again—but could you let me see a leaf?"

"Surely. Betty, snip off a small leaf

of the violet with these scissors and give it to our Mystic friend, please."

Jerry again examines the leaf.

"Wave the wand of magic and call a number from one to one thousand, Jerry. What do you say, oh man of wisdom?"

"I'll say five!"

"*Right again!*", squealed Betty, who had taken a peek while collecting the leaf.

"And now, my sage, rest not on your laurels, but gird your loins for the truly acid test." (From his lab coat the instructor takes a seed of a lemon and hands it to the young magician who is now enjoying his role with genuine enthusiasm.)

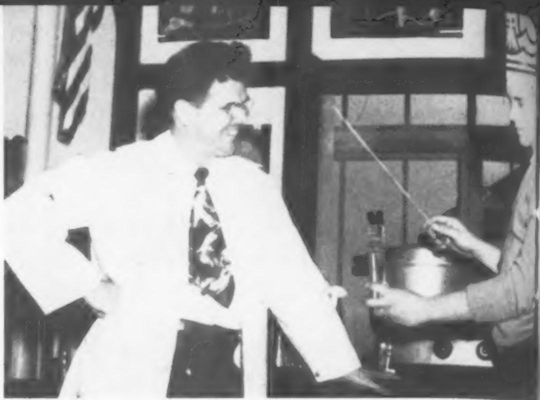
"Regal man of thought, please inform the class as to whether you have ever seen a lemon tree."

"No, I have never seen a lemon tree," replied Jerry, but he can hardly suppress a smile as he examines the seed. He is really in the swing of the reasoning now and having a grand time.

"Wave the wand of great thought, wise one, and with this scalpel examine the lemon seed closely."

Jerry quickly discerns the seed to be a dicot.

"Now, my Wizard, inform the class as to the nature of the leaves and flowers of the plant you have never seen."



Jerry enjoys his role as MYSTIC RULER. Photo by George Lindberg, student in Crystal Lake Community High School.

"I have quite a clear picture of this lemon tree," replies Jerry, now waving the wand and going through magic motions to the delight of the class. "The leaves are net veined and the flower parts are probably in groups of fours or fives. I'll even go further and surmise that if the stem of this plant were cut, the vascular bundles or tissue would form a cylinder rather than being scattered like in a corn stem."

"Splendid, Jerry. Very well done, indeed. You may take your seat now and I want to thank you sincerely for the part you have just played in impressing upon all of us the importance of at least a meager knowledge of plant morphology. Jerry has described the flower, stem and leaf of a plant that he has never seen. All he needed was a look at the seed. Go forth, ever applying your knowledge of science, class—then all of you shall truly be mystics."

# Membership

Although under the present plan this is not the end of the fiscal or membership year, it is a break in the school year and therefore a logical time to take stock of membership. In previous years the annual membership report was made in May, the nearest issue to the end of the fiscal year.

This report is not strictly comparable to those of previous years but is approximately so. There are still a few short term and irregular memberships as a result of the change of fiscal year and the fact that Volume 9 had eleven numbers instead of the usual eight.

In the following table the figures for 1945 and 1946 are the total memberships for the fiscal years 1944–5 and 1945–6 respectively; the figures for 1947 and 1948 are as of approximately May 1. This is of course not the total membership for the year but does

come near enough to show that we are not making as much progress as we should.

A study of the table will show that the membership increased in a few states and in the foreign countries, but that many states show a decrease.

| | 1945 | 1946 | 1947 | 1948 |
|---|---|---|---|---|
| Alabama | 22 | 20 | 11 | 10 |
| Arizona | 6 | 6 | 5 | 5 |
| Arkansas | 4 | 6 | 4 | 3 |
| California | 129 | 123 | 99 | 89 |
| Colorado | 17 | 21 | 19 | 17 |
| Connecticut | 32 | 41 | 34 | 31 |
| Delaware | 3 | 6 | 3 | 4 |
| District of Col. | 25 | 28 | 23 | 19 |
| Florida | 8 | 8 | 8 | 9 |
| Georgia | 7 | 10 | 9 | 7 |
| Idaho | 4 | 4 | 4 | 2 |
| Illinois | 208 | 244 | 197 | 186 |
| Indiana | 81 | 83 | 77 | 89 |
| Iowa | 44 | 37 | 33 | 39 |
| Kansas | 35 | 35 | 30 | 28 |
| Kentucky | 18 | 18 | 14 | 17 |
| Louisiana | 14 | 11 | 12 | 7 |
| Maine | 6 | 10 | 10 | 9 |
| Maryland | 30 | 43 | 43 | 45 |
| Massachusetts | 90 | 86 | 94 | 78 |
| Michigan | 89 | 112 | 86 | 85 |
| Minnesota | 34 | 31 | 24 | 31 |
| Mississippi | 7 | 11 | 8 | 6 |
| Missouri | 25 | 47 | 37 | 37 |
| Montana | 11 | 11 | 4 | 4 |
| Nebraska | 13 | 26 | 16 | 13 |
| Nevada | 0 | 0 | 3 | 3 |
| New Hampshire | 16 | 14 | 14 | 15 |
| New Jersey | 55 | 66 | 53 | 48 |
| New Mexico | 3 | 8 | 3 | 2 |
| New York | 158 | 190 | 161 | 164 |
| North Carolina | 25 | 34 | 25 | 20 |
| North Dakota | 6 | 7 | 12 | 12 |
| Ohio | 158 | 162 | 137 | 124 |
| Oklahoma | 12 | 15 | 14 | 22 |
| Oregon | 33 | 42 | 38 | 26 |
| Pennsylvania | 169 | 169 | 137 | 131 |
| Rhode Island | 13 | 9 | 9 | 12 |
| South Carolina | 7 | 6 | 6 | 9 |
| South Dakota | 6 | 11 | 7 | 7 |
| Tennessee | 13 | 22 | 19 | 18 |
| Texas | 30 | 33 | 26 | 38 |
| Utah | 0 | 9 | 4 | 4 |
| Vermont | 4 | 8 | 8 | 6 |
| Virginia | 50 | 43 | 30 | 26 |
| Washington | 23 | 27 | 21 | 17 |
| West Virginia | 20 | 30 | 35 | 22 |
| Wisconsin | 67 | 81 | 80 | 71 |
| Wyoming | 2 | 3 | 1 | 3 |
| Alaska | 1 | 1 | 0 | 0 |
| Hawaii | 2 | 3 | 4 | 5 |
| Canal Zone | 2 | 2 | 1 | 1 |
| Puerto Rico | 5 | 9 | 4 | 6 |
| Africa | 0 | 1 | 0 | 3 |
| Canada | 10 | 14 | 15 | 20 |
| Mexico | 1 | 1 | 1 | 2 |
| Australia | 0 | 1 | 3 | 3 |
| Belgium | 0 | 0 | 1 | 0 |
| Brit. W. Indies | 0 | 0 | 1 | 0 |
| China | 0 | 0 | 2 | 2 |
| Cuba | 0 | 0 | 4 | 3 |
| Finland | 0 | 0 | 1 | 0 |
| Holland | 0 | 0 | 1 | 2 |
| India | 1 | 1 | 2 | 1 |
| Palestine | 0 | 0 | 1 | 2 |
| Philippines | 0 | 0 | 2 | 1 |
| South America | 3 | 3 | 3 | 5 |
| Sweden | 0 | 1 | 2 | 1 |
| U.S.S.R. | 0 | 0 | 1 | 3 |
| Denmark | 0 | 0 | 0 | 1 |
| Total | 1859 | 2104 | 1796 | 1731 |

# Science and Security

E. U. CONDON

Director, National Bureau of Standards

*(Continued from April issue)*

The basic conflict may be stated thus: Restriction of information is designed to conserve a static position based on present knowledge. Science can only grow and develop by a wide distribution of information about its results in order to bring new young minds to bear on its problems. Although science for its own sake is a good thing, I here want to focus attention only on the slowing down of possible military application which a stagnation of science would produce.

Therefore, if we doubt policies that are too restrictive about our present knowledge we stifle the growth of that knowledge. The price we have to pay in order to grow in knowledge is some giving up of present knowledge in order that we may continue to grow. From the strictly military point of view it is just as important that we get some new secrets to keep us that he hold on to the old ones. Scientific secrets deteriorate when stock piled.

There is another point which is important with regard to this country's position in par-

ticular. If we adopt policies that are too restrictive about scientific knowledge, other countries will also do the same. As Charles Kettering of the General Motors Corporation has put it, "When you lock the doors of the laboratory, you lock out more than you lock in." This result could be especially weakening to America for we have not thus far been very productive in truly fundamental science. On the other hand we are very well equipped to make rapid progress in exploiting technological uses of such fundamental knowledge. For these reasons we have to guard against policies that are so narrowly restrictive that we stifle our own development.

It would be most unfair if anyone who has heard me say what I have just said were to go out and say that I talked against secrecy, or that I advocated giving away the so-called secret of the atomic bomb. I do not now and never have held such a position. In particular, I have never advocated giving away any information about our atomic bomb. I have, however, repeatedly stressed the point that what we could learn by research with the aid of our British friends and many valuable refugees from Hitler's Germany and Mussolini's Italy, can also be learned in time by any group of scientists. And therefore whether we like it or not we cannot found any policy on the belief that we have anything but a very temporary monopoly in this field. It does not, however, follow that we should not hold on to this temporary advantage for what it may be worth. In the last analysis the problem of restriction is one requiring a delicate balance between the benefits of disseminating and restricting information which only experts can determine.

### Attitudes Toward Scientists

My second main point is this: Scientists are not deserving of, nor should they get, any *better* treatment than the rest of our citizenry with regard to procedures of investigation designed to pass on their probable personal integrity and reliability. But it ought also to be admitted that scientists should not be regarded as intrinsically or a priori less reliable than the rest of our people. And yet there are those who seem to start with the assumption that a scientist is a peculiarly unstable fellow with no sense of responsibility or capacity for living according to the rules. They seem to start from the false assumption that he is guilty of incapacity in this direction unless he can prove himself innocent.

One thing that never seems to occur to some of those who worry so loudly about the discretion of scientists is that the information in question, in many instances, was not given by the government to the scientist in the first place. Rather it was given by the scientists to his government. And as many of us know from personal experience it was sometimes most difficult to get the government to listen.

The history of the atomic bomb project is an interesting case in point. News of the discovery of uranium fission reached this country in January 1939 from Germany. Within a short time quite a few American physicists recognized the possibility of useful release of atomic energy and of making an atomic bomb. Then started a process of trying to interest the government with no apparent action resulting. We physicists in the meantime voluntarily adopted secrecy policies which kept this information from the public and from other countries.

After some months of frustration a direct appeal to the President was made and he saw to it that a program of work was started under the general supervision of my predecessor, Dr. L. J. Briggs. The secret was so well kept that most of the staff of the National Bureau of Standards were unaware of the existence of an atomic bomb project before the official announcement was made.

### Compartmentalization in Science

Detailed practices were quite different in different projects. I can only speak from first-hand knowledge of two of them: microwave radar and the atomic bomb. This brings me to the subject of *compartmentalization*. By compartmentalization in the jargon of secrecy policies is meant the policy of not allowing a man to know any more that he needs to know in order to play his part in the working organization.

The theory back of this, I suppose, is that if somehow he should fail to be reliable, the less he knows the less he can tell. The idea is easily applicable in military operations. Very few need to know the over-all war plans: others will be given orders covering their part when their time comes. It is conceivable that a navy gunner does not need to know anything about the radio on his ship, and so on.

It is likewise quite true that a minor employee in a scientific research laboratory does not need to know what the overall objective of the laboratory is. If it is his job to wire up and adjust some specialized electronic gear according to fairly explicit directions, he is not hampered in his work by not knowing what the gear is for.

*(To be Concluded)*





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